# Part I
# mobile-Healthcare와 NI 플랫폼

의료생명과학(애플리케이션/의료기기 인증교육)
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## 의료 기술 세미나 순서

- 14:00 – 15:00
  - Part I 모바일 헬스케어 환경 과 NI 시스템 (NI 의료생명과학 김광현 과장)
- 15:00-15:30
  - Part II 모바일 헬스케어 시스템 데모 (이노템즈 정재상 차장)
- 15:30-15:40
  - 휴식
- 15:40-17:00
  - Part III 생체신호계측 NI Biomedical Toolkit 핸즈온 세미나 (NI 의료생명과학 김광현 과장)

*• 리드시트 제출시 NI 기념품, 이노템즈사 기념품을 제공해 드립니다.*
*• 세미나 참석자 분들께 추첨을 통하여 NI에서 소지품 정리 패드/랩뷰 도서를 드립니다.*
*• 참석 공문이 필요하신 분께서는 리드시트에 적어 주시기 바랍니다.*

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# 목차

- Part I
  - 스마트폰과 태블릿 PC를 이용한 측정과 컨트롤 기술 동향
  - Mobile Healthcare 시스템 정의 및 기술 동향
  - NI mobile Healthcare 시스템
  - NI m-Healthcare 사례

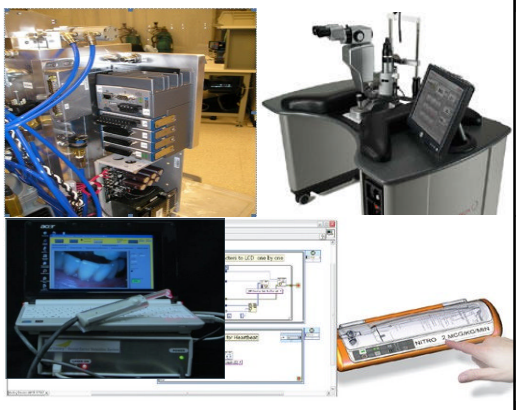

NATIONAL INSTRUMENTS

# NI 의료기기 기술 적용 분야

개발(설계) → 테스트 (SW V&V) → 양산 (OEM)

소프트웨어 밸리데이션 중심으로,
NI Graphic System Design
측정, 제어 시스템 기술 활용

- 영상 진단 기기 (Medical Imaging)
  - 초음파, X-ray, CT, MRI, OCT, 내시경
- 치료 기기 (Therapy)
  - 방사선 치료기, 유방종양 치료기
- 체외진단기, 헬스케어 기기 (Diagnosis)
  - IVD, PCR, PMS, 모바일 기반 의료기기
- 의료 로봇 시스템 (Medical Robotics)
  - 수술로봇, 병원자동화 로봇
- 기타 의료기기 (Medical device test)
  - 스텐트, 와우장치, 심장제세동기



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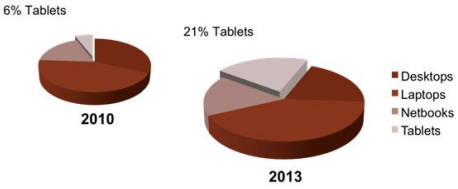
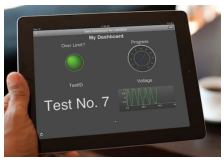
## 스마트폰과 태블릿 PC를 활용한 측정과 컨트롤

- 전세계 스마트폰 판매량은 지난 2011년에 약 5억 대 가까이 판매되었으며, 이 수치는 2010년보다 58 퍼센트 증가한 수치[Gartner Research]




- 2013년, 태블릿 PC가 데스크탑 컴퓨터의 판매량을 앞지를 것이라고 전망 [Forrester Research]

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## 스마트폰과 태블릿 PC를 활용한 측정과 컨트롤

- 그렇다면, 스마트폰과 태블릿 PC에 대한 측정과 제어 분야의 활용성은?
  - 이 기기들은 엔지니어들이 제품을 설계, 검증 및 생산하기 위해 사용하는 가장 중요한 툴 중에 하나이기도 함.
  - 스마트폰과 태블릿 PC는 시스템을 원격으로 측정하고 제어할 수 있으며, 휴대용 측정을 위한 새로운 플랫폼을 제공함.
  - 휴대성과 웹 연결 기능을 갖춘 스마트폰과 태블릿 PC를 이러한 업무에 활용한다면 그 범위는 더욱 넓어질 것

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## M-Healthcare의 정의

- 모바일(Mobile) 기술을 활용한 보건의료서비스로정의
- Mobile-Healthcare System은 모바일 기술을 활용한 의료서비스 시스템
  - 예) 태블릿 PC, 휴대전화 사용한 건강 정보 측정, 분석, 데이터 표현, 전송, 진단, 치료 등 이와 관련한 모든 서비스
- 모바일 기술과 보건 의료의 서비스의 통합과 시스템의 효율성을 증대시키고, 다양한 형태의 고품질 서비스를 실현하는 것이 관건

한국보건산업진흥원 보고서 일부 발췌

NATIONAL INSTRUMENTS

## NI Mobile Healthcare System


NATIONAL INSTRUMENTS

# Many Use Cases for Combining LabVIEW, NI Systems, & Mobile Technology

HMI for Measurement and Control Systems | View Measurement Data Stored in the Cloud | Configure and Debug Hardware Devices | View, Run, and Edit LabVIEW VIs

Learn STEM Concepts | Make Measurements in the Field | Aid LabVIEW Usage on the Desktop | View, Edit, and Simulate Circuits

NATIONAL INSTRUMENTS


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# cDAQ-9191

- **NI CompactDAQ 1-Slot Ethernet and 802.11 Wi-Fi Chassis**

•Send data to a host PC over Ethernet or IEEE 802.11 Wi-Fi
•Use 4 general-purpose 32-bit counter/timers built into the chassis (access through digital module)
•Stream continuous waveform measurements with patented NI Signal Streaming technology
•Measure in minutes with NI-DAQmx software and automatic code generation using the DAQ Assistant
•Choose from more than 50 NI C Series hot-swappable I/O modules with integrated signal conditioning

NATIONAL INSTRUMENTS

# 1. Data Acquisition with Windows Tablets

**LabVIEW, NI Drivers OS Support**
☑ Windows 7
☑ Windows 8/Pro/Enterprise
☑ Windows 8 Pro
☑ Windows 8 Enterprise
☐ Windows 8 RT

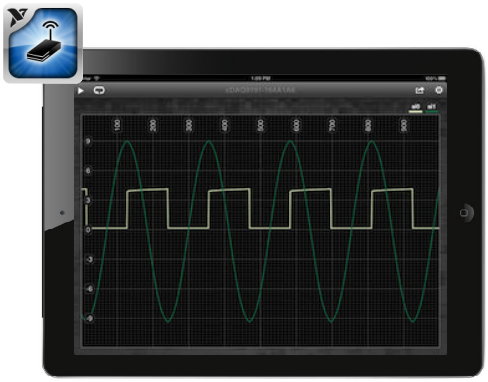
NATIONAL INSTRUMENTS

## 2. Data Acquisition with iOS & Android

NI cDAQ-9191

*Requires firmware upgrade (ni.com/labs)*

NI cDAQ-9191 Data Display



**Supported C Series Modules**

- NI 9215 (Voltage, 4-ch, 100kS/s/ch)

Google play | Available on the App Store | Custom Applications

NATIONAL INSTRUMENTS

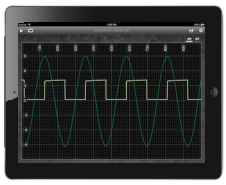
### 1. Connect Through Infrastructure


cDAQ-9191

Web Service hosted o n device

**Network**
Local/Internet

NI cDAQ-9191 Data Display

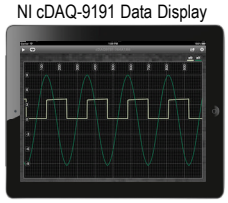


### 2. Direct Connect


cDAQ-9191

Web Service + Access Point hosted on device

NI cDAQ-9191 Data Display



NATIONAL INSTRUMENTS

# Many Use Cases for Combining LabVIEW, NI Systems, & Mobile Technology

HMI for Measurement and Control Systems | View Measurement Data Stored in the Cloud | Configure and Debug Hardware Devices | View, Run, and Edit LabVIEW VIs

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NATIONAL INSTRUMENTS


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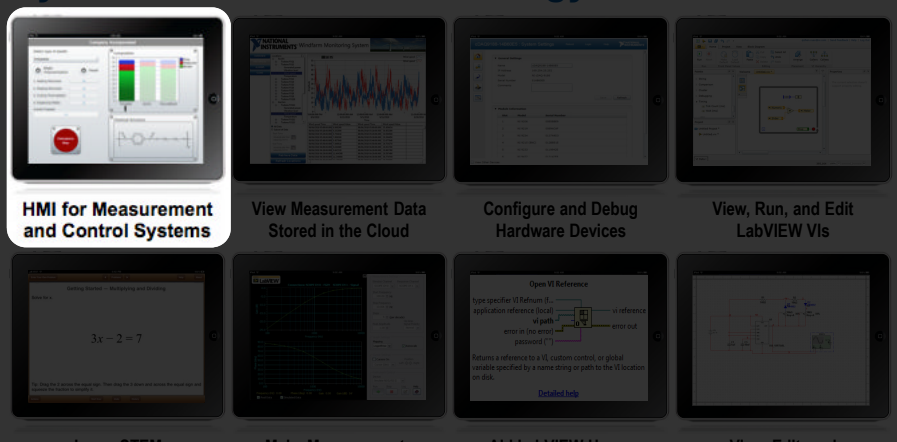

HMI for Measurement and Control Systems | View Measurement Data Stored in the Cloud | Configure and Debug Hardware Devices | View, Run, and Edit LabVIEW VIs

Learn STEM Concepts | Make Measurements in the Field | Aid LabVIEW Usage on the Desktop | View, Edit, and Simulate Circuits

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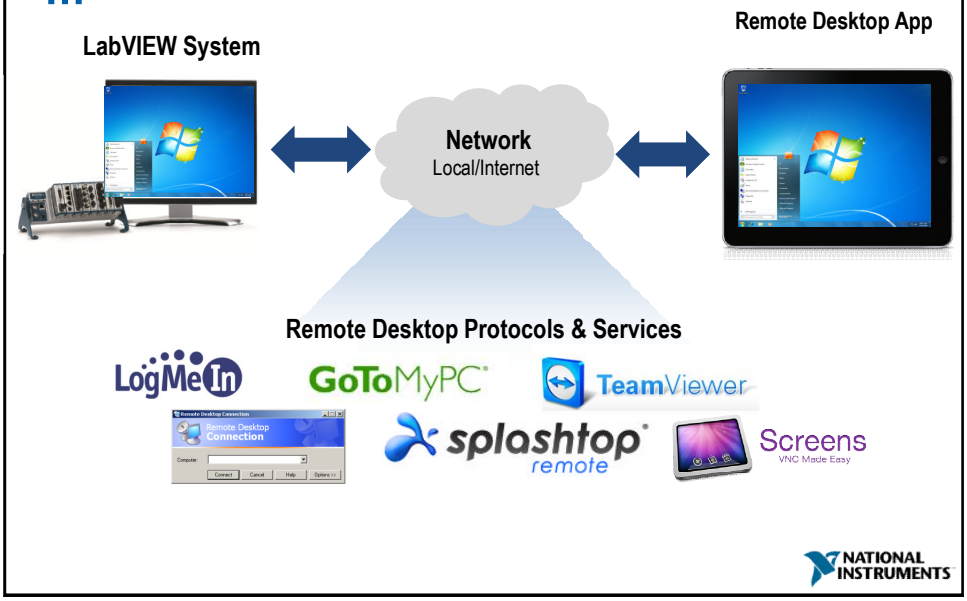
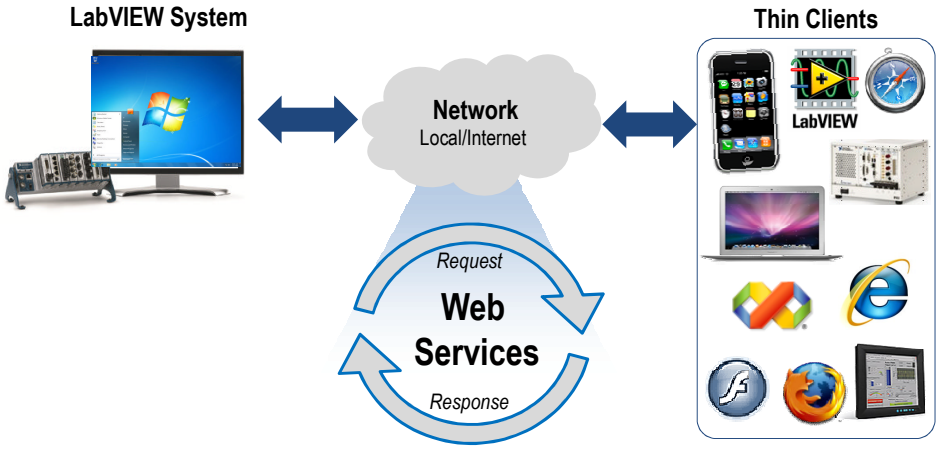
## 1. Send SMS Alerts from LabVIEW

- Example code available on the NI Community

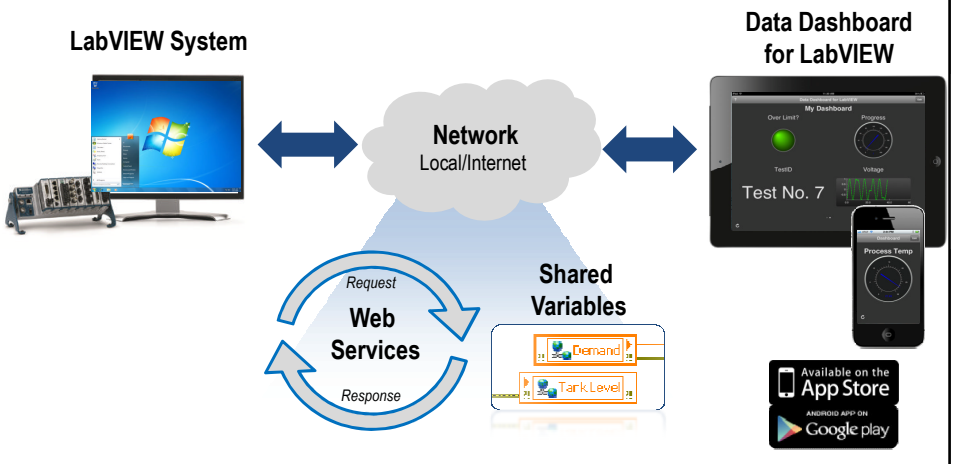

## 2. Remote Desktop into a LabVIEW System



## 3. Build Your Own Mobile Thin Clients




## 4. Data Dashboard for LabVIEW



## Meet the New and Improved Data Dashboard for LabVIEW.


Available on the App Store

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## New Data Dashboard for LabVIEW Features (iPad)

- Create custom layouts (place dashboard elements freely)
- Add controls as well as indicators
- Share dashboards via email or the NI Cloud
- Connect to data using secure or non-secure web services or network-published shared variables
- Customize the look and feel of individual dashboard elements
- Define background colors or use an image
- Create many dashboards and make single dashboards multi-page
- Access data from the NI Technical Data Cloud

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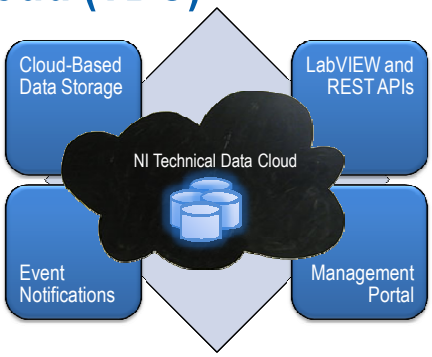
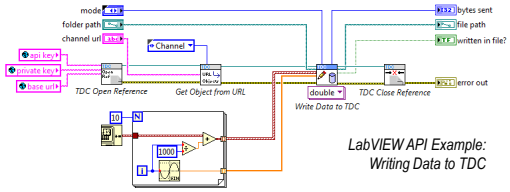
# NI Technical Data Cloud (TDC)

- Cloud-based services f or global data aggregati on and access
- High availability and sc alability
- Optimized, secure data model and APIs




*LabVIEW API Example: Writing Data to TDC*

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# Summary of Technologies

- **Portable Data Acquisition**

1. DAQ w/ Windows Tablets ➔ *LabVIEW & NI-DAQmx*
2. DAQ w/ iOS/Android Tablets ➔ *cDAQ-9191 Data Display*

- **Remotely Monitor LabVIEW Systems**

1. Send SMS Alarms w/ LabVIEW ➔ *Example Code on NI Community*
2. Remote Desktop into LabVIEW Systems ➔ *Remote Desktop Software*
3. Build Your Own Thin Client App ➔ *LabVIEW Web Services, cDAQ-9191 Web API*
4. Mobile HMI for LabVIEW Systems ➔ *Data Dashboard for LabVIEW*

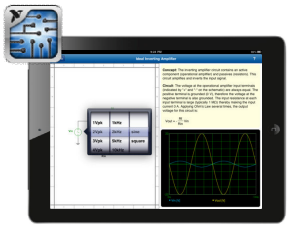
NATIONAL INSTRUMENTS

# Additional NI Mobile Apps (ni.com/mobile)

LabVIEW Intro


NI DAQ Device Pinouts


Multisim Circuit Explorer



NI SRManager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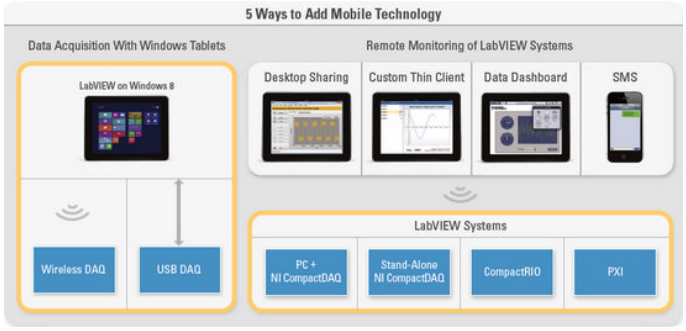
# Mobile Healthcare for Measurement and Control

- Mobile devices, including smartphones and tablets, are increasingly being adopted for measurement and control applications. Their evolving functionality and use cases include visualization capabilities and connectivity to wireless hardware devices.

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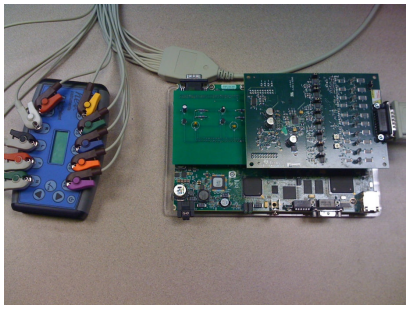
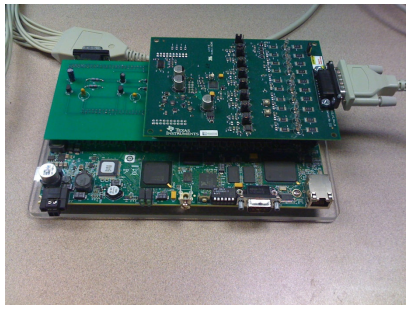
# The Completed Prototype

- Designers require a solution such as an evaluation board to prototype their systems. However, these boards often do not include all the signal chain components needed for an application, as well as rarely include vision, motion, or ability to synchronize I/O. Additionally, designers often have to waste time developing custom boards for sensors or specialized I/O, just to complete a proof of concept. Using flexible commercial off-the-shelf (COTS) prototyping platforms from National Instruments and Texas Instruments can truly streamline design, and eliminate much of the work required for hardware verification and board design. Figure 9 shows our complete solution to ECG measurement analysis and embedded control. The ECG simulator used is a product from HE Instruments.





NATIONAL INSTRUMENTS

# Electrocardiography (ECG) Reference Design

| Component | Notes |
|---|---|
| Hardware | |
| Texas Instruments ECG Analog Front End reference design kit | Source: Texas Instruments TMDXMDKEK1258 Electrocardiogram (ECG) Analog Front End (AFE) |
| NI Single Board RIO Embedded Evaluation kit | The ECG Starter Kit uses the NI sbRIO-9631; the NI Embedded Evaluation Kit includes a sbRIO and evaluation versions of LabVIEW, LabVIEW Real-Time module, and LabVIEW FPGA module. |
| Adapter to connect the NI sbRIO to the TI ECG Analog Front End board | Custom designed and ordered; described in the NI sbRIO Adapter to the Texas Instruments Electrocardiogram (ECG) Analog Front End Module document. |
| 12 lead ECG cable | Standard, off-the-shelf 12 lead ECG cable |
| ECG simulator (optional) | Used for testing and demonstration purposes. |
| Software | |
| LabVIEW Professional Development Environment | *Evaluation version can be downloaded here |
| LabVIEW Real-Time Module | *See the product page for LabVIEW Real-Time Module |
| LabVIEW FPGA Module | *See the product page for LabVIEW FPGA Module |
| LabVIEW Digital Filter Design Toolkit | See the product page for Digital Filter Design Toolkit |
| LabVIEW FPGA IP to control the TI ADS1258 16-Channel, 24-Bit ADC | Tutorial and download of LabVIEW FPGA IP for Texas Instruments ADS1258 16-Channel, 24-Bit ADC |
| Electrocardiography ECG Starter Kit Application Software | Tutorial and download of Electrocardiography ECG Starter Kit Application Software |

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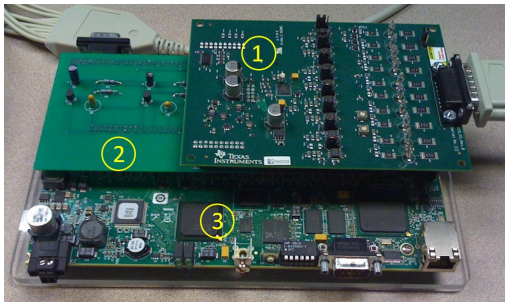
- *The embedded hardware that composes the ECG Reference Design Embedded Starter Kit is (1) the Texas Instruments TMDXMDKEK1258 Electrocardiogram (ECG) Analog Front End (AFE), (2) the custom-designed adapter board, and (3) NI Single Board RIO-9631.*
- **Texas Instruments TMDXMDKEK1258 Electrocardiogram (ECG) Analog Front End (AFE)**




- The Texas Instruments TMDXMDKEK1258 Electrocardiogram (ECG) Analog Front End (AFE) module (Figure 3) reads 8 out of 12 ECG leads as analog signals and provides the digital output to the LabVIEW-based, processing subsystem of the FPGA and real-time processor. The front-end board is interfaced with the NI sbRIO board through the custom adapter board connector. The 16 channel analog-to-digital converter (ADC) (ADS1258) is configured for a 500Hz sampling rate per channel and has 24-bit data resolution. The sbRIO controls the ADC with SPI communication and has the ability to do I2C communication to implement lead-off detection.

- The ECG cable consists of ten leads, which are connected in the standard, 12-Lead ECG configuration with four limb leads and six chest leads. The other end of the cable is connected to the front-end board through the DB15 connector. The ECG electrodes pick up ECG signals from the ECG simulator or test subject and send them to the ECG front-end board.
- The Texas Instruments front-end board reference design can perform the following actions:
  - Right leg driving circuit
  - Lead-off detection
  - Derivation of eight ECG leads using instrumentation amplifiers
  - Low-pass filtering (anti-aliasing)
  - Analog-to-digital conversion (ADC)
- For a complete description of the TI front-end board, review the ECG Implementation on the TMS320VC5505 DSP Medical Development Kit (MDK) user manual. As stated in the user manual, operational amplifiers are used to create measurements for Lead I and Lead II, and the eight ECG leads are formed using the following relationships:
- Lead I = Left Arm - Right Arm
- Lead II = Left Leg - Right Arm
- Lead V1 = V1 - (Left Arm + Right Arm + Left leg)/3
- Lead V2 = V2 - (Left Arm + Right Arm + Left leg)/3
- Lead V3 = V3 - (Left Arm + Right Arm + Left leg)/3
- Lead V4 = V4 - (Left Arm + Right Arm + Left leg)/3
- Lead V5 = V5 - (Left Arm + Right Arm + Left leg)/3
- Lead V6 = V6 - (Left Arm + Right Arm + Left leg)/3
- Lead III, Lead aVR, Lead aVL, and Lead aVF are calculated in software using Lead I and Lead II. These calculations are discussed in more detail in the **Electrocardiography (ECG) Starter Kit Application Software** article.

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# NI Embedded Evaluation Kit

- The NI Embedded Evaluation Kit (Figure 5) is the last hardware component to the Electrocardiography ECG Reference Design Embedded Starter Kit. Included in this kit is everything needed to evaluate the NI LabVIEW Real-Time and LabVIEW FPGA programming experience used to develop embedded applications for NI reconfigurable I/O (RIO) hardware platforms such as CompactRIO, integrated RIO, NI Single-Board RIO, and R Series devices. This kit includes a guided experience to show how to configure and program embedded LabVIEW applications for real-time microprocessors and field-programmable gate array (FPGA) devices.
- To create the ECG Reference Design, connect the NI sbRIO-9631 to the adapter, which connects to the TI ECG Analog Front End. Power and ethernet are the only other connections required to complete the hardware aspect of the ECG Reference Design.


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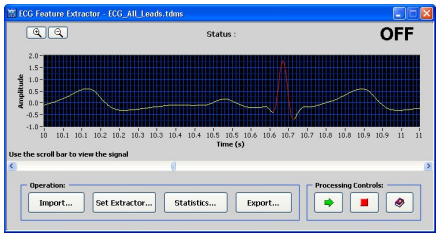
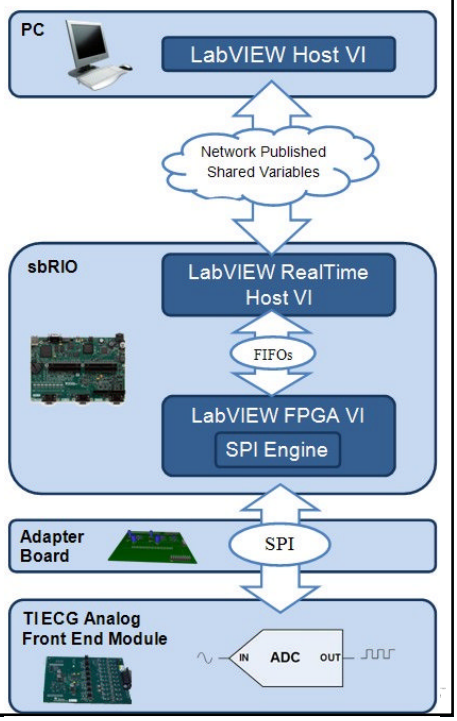
# System Architecture


# Disclaimer

- **Not for Diagnostic Use: For Feasibility Evaluation Only in Laboratory and Development Environments.**
  - The adapter along with the NI SBRIO and TI Analog EVM front end must not be used for diagnostic purposes.
  - The adapter along with the NI SBRIO and TI Analog EVM front must not be used with other equipment that produces high voltages
  - This adapter along with the NI SBRIO and TI Analog EVM front are intended solely for evaluation and development purposes. They are not intended for use and may not be used as all or part of an end equipment product.
  - This adapter along with the NI SBRIO and TI Analog EVM front should be used solely by qualified engineers and technicians who are familiar with the risks associated with handling electrical and mechanical components, systems and subsystems.
  - Use only the proper power supplies for the adapter along with the NI SBRIO and TI Analog EVM front module.

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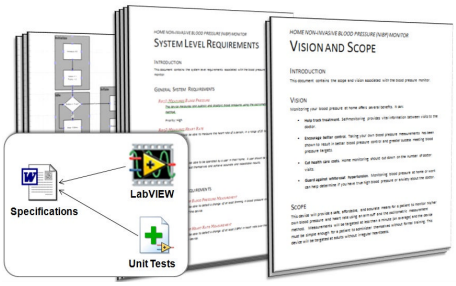
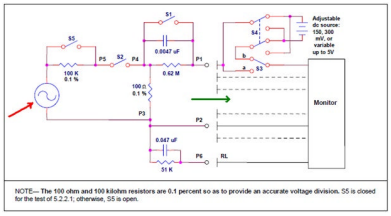
## Testing Your ECG (EKG) Products to ANSI/AAMI EC13



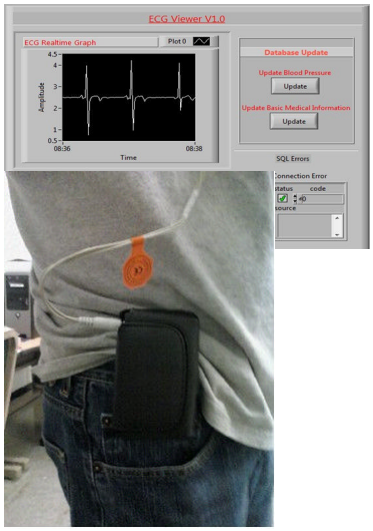

NATIONAL INSTRUMENTS

## Case Study

NATIONAL INSTRUMENTS

# Performing Wireless, In-Home ECG Monitoring With Remote Access Using NI LabVIEW

- "Using NI LabVIEW software and compatible hardware to create an automated ECG monitoring device so that senior citizens and other populations can have their ECGs monitored and analyzed without leaving their residences."
- - Logan Porter, University of North Texas College of Engineering
- **해결 과제:**
  Building a compact, easy-to-use, wireless electrocardiogram (ECG) monitoring system that offers remote access for senior citizens and people in remote areas without immediate access to medical diagnosis.
- **솔루션:**
  Using NI LabVIEW software and compatible hardware to create an automated ECG monitoring device so that senior citizens and other populations can have their ECGs monitored and analyzed without leaving their residences.

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# Telediagnosis System in Ambulance using LabVIEW for Student Design Competition 2013

Thiagarajar College of Engineering, Madurai.

- **The Challenge**
- To develop a system that will transmit the essential details of a person to the hospital personnels and will also send the current position of the ambulance to the traffic control room.
- The time that an ambulance takes to reach the hospital (also called the GOLDEN HOUR) and the time taken by the hospital authorities to understand the condition of the patient are crucial in saving a patient's life. Many incidents have been reported that due to the traffic congestions and traffic jams the ambulance gets stranded in the road and in the worst case, this delay due to the traffic issues have even proved fatal. The proposed system will transmit the details of the patient to the hospital thereby reducing the prehospital setting time and will update its position to the traffic control room, so that the route is cleared if possible or the ambulance is informed to take an alternate path that is clear.
- **Benefits of using NI graphical design:**
- o This application mainly deals with the acquisition of data, displaying it in graphs and
- o then getting the latitude and longitude of a point and displaying it in the map. Hence the features of the graphical language have made the implementation easy. If graphical language is not to be used then the implementation would have been very complex.
- o The training required to perform the measurements in graphical language is much easier and comes handy in case of emergencies involving mass disaster.
- o The codes written by us got easily integrated using LabVIEW.
- o With the debugging tools in LabVIEW, the execution can be slowed down and the data flow can be seen through the block diagram. The combination of working with higher-level building blocks and improved visibility into our application's execution results in far less time spent tracking down bugs in our code.
- o The errors can be easily detected and rectified.
- o The codes can be re used in LabVIEW. This saves a lot of time and also reduces code's complexity.
- o The LabVIEW software makes the interfacing very much easier. With the DAQmx cards the data acquisition is fast and more accurate.
- o The Compact RIO allows to get real time signals and NI modules for GSM and GPS are also very useful .
- o LabVIEW has a optimising compiler and help in creating efficient machine code.
- o With LabVIEW, we can create executable files that can run on any PC without having LabVIEW installed.
- o The LabVIEW biomedical workbench helps us to process the signal much easily and accurately.

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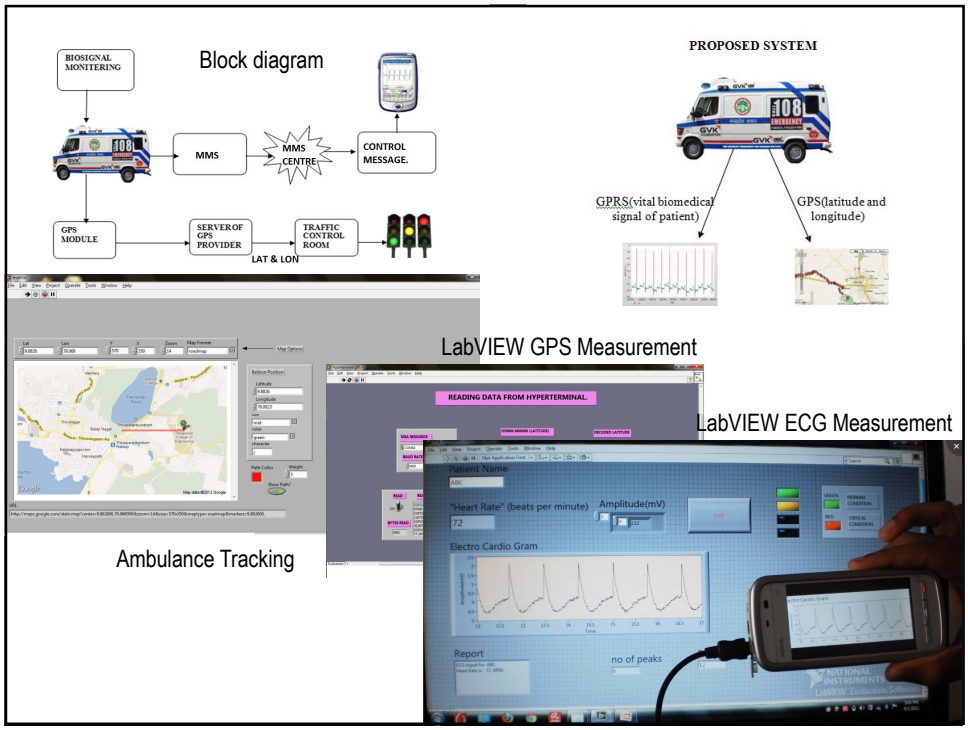
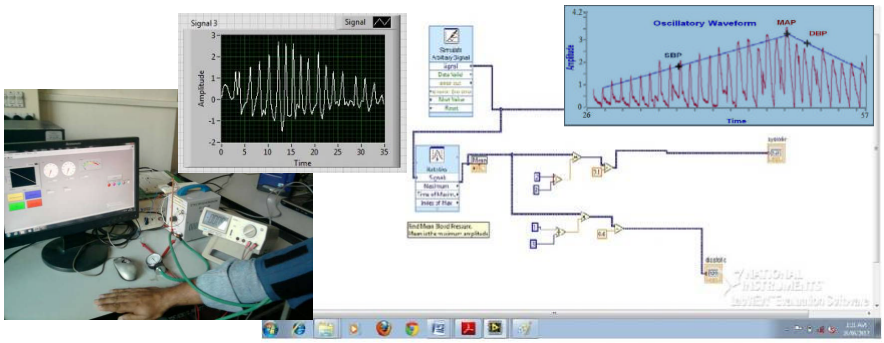



## Wellcare Health Analyzer in Student Design Competition

College : Sardar Patel Institute Of Technology

- The wellcare health analyzer system automatically communicate necessary information to healthcare providers for remote health monitoring.
- LabVIEW simulation software , DAQ Card (PCI - 6251),NI myDAQ for real time data aquisition, MPX5050GP Pressure Sensor, AT89S52 microcontroller, plethysmographic heart rate sensor, LM 324 IC for infusion monitor.



# Virtual Doctor An advance Telemedicine system

- **1. Introduction**
- With the emergence of economies, government around the globe is facing a problem to provide the health services to people and the cause behind this problem is the scarcity of health services provider.
- To achieve better health care services above problem can be solved by the help of modern computers and telecommunication technologies and now it is feasible to design home based telecommunication system to acquire, record display and transmit the signal from human body to any location.
- **2. System Architecture**
- The Virtual Doctor is the, video based system to specifically address the needs of the healthcare industry. It provides portable video based capability for collaborative and diagnostic purposes in a clinical environment.
- The Real time vital parameter transmitting system schematic is shown in Fig. comprises of both hardware and software components. Hardware components like Data acquisition card, temperature sensor, heart beat and blood pressure sensor ensures the proper signal acquisition while software part (Labview VI's) is taking care of signal transmission over the internet and visualizing the acquired data on the computer screen.

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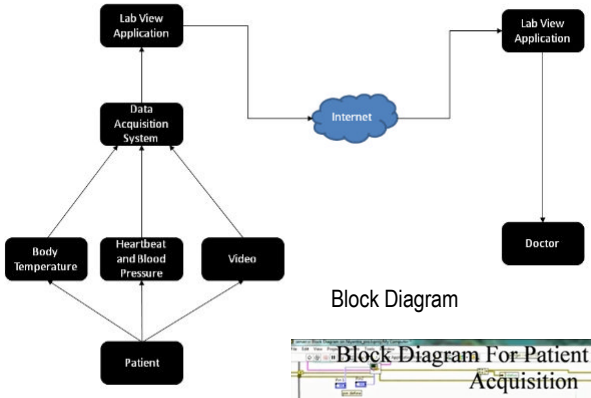
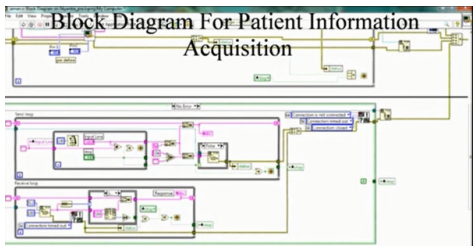



Block Diagram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## 질의 응답


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